GCP: Gossip-based Code Propagation for Large-scale Mobile Wireless Sensor Network

Yann Busnel, Marin Bertier, Eric Fleury, Anne-Marie Kermarrec

GCP: Gossip-based Code Propagation for Large-scale Mobile Wireless Sensor Network

Name: Yann Busnel
E-mail: Yann.Busnel@irisa.fr
Student: yes

Collaboration work with: Marin Bertier, Eric Fleury, Anne-Marie Kermarrec

Extended abstract

Wireless sensor networks (WSN) are in a plentiful expansion. They are expected to be deployed for long periods of time, and the nodes are likely to need software updates during their lifetime. Updating the software code automatically on a huge number of sensors is a tremendous task, which is infeasible "by hand" when all participating sensor are moving. In this work, we are interested in an automatic software update of devices in sensor-based applications where sensors are mobile and no localisation mechanism is available. We consider the use of a peer-to-peer cooperation paradigm into the WSN architecture as a way to provide the entire network with the ability to find a good tradeoff between reliability and scalability of code propagation. Effectively, P2P systems are fully decentralized, self-organized where each node may act both as client and server. Especially, gossip-based protocols, based on continuous information exchange between participating nodes, is a very promising candidate for propagating information in WSNs.

In this work, we present the design and the evaluation of GCP (*Gossip-based Code Propagation*), a distributed software update algorithm. To the best of our knowledge, tackling code propagation in *mobile* WSN has not been considered so far. Leveraging works both on epidemic protocols and, on similarities and differences between P2P systems and mobile WSN, *Gossip-based Code Propagation* algorithm tends to outperforms classical dissemination algorithms, with only a small overhead by adding little extra informations on sensor nodes and in beacon messages. GCP uses information about sensors and their dynamic neighbourhood to improve significantly the load balancing without sacrificing the propagation speed.

We compare GCP against two different dissemination algorithms: one ideal in speed convergence but requiring a large number of software send messages and, therefore, a very high power consumption, and a second one trying to optimize on load balancing. In order to evaluate our contribution, we developed SeNSim, a software simulator implemented for mobile wireless sensor-based applications' simulation. Several simulated experimentation were conducted: eight synthetic and one realistic[1] scenarios have been simulated.

Simulation results based on both synthetic and realistic workloads, show that GCP allows ideal convergence speed and evenly balances the load between sensors in the system. For each of these algorithms, GCP outperforms the other candidate approach accordingly to the few overhead informations. With a clearly load balance on the system, GCP can disseminate the new software with almost the same propagation speed than the ideal one.

One of this work perspectives consists in including the *Delay Tolerant Networks* (DTN) paradigm into GCP in order to take into account and optimize the free receptions of the software due to the omnidirectionnal wireless transmission.

Keywords

Wireless sensor network, mobile computing, large scale, diffusion, software update, algorithm, simulation

[1] We used the mit/reality data set from CRAWDAD for the analysis. This realistic workload has been collected from a one year long-experimentation at MIT over the course of the 2004-2005 academic year.